

CHAPTER 2

Methodology

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This section summarizes the approaches used to evaluate the status and trends of environmental and socioeconomic indicators relative to adopted TRPA Threshold Standards, and local, state and federal air and water quality standards. In addition, this section:

1. Defines key terms
2. Further describes the content of Indicator Summaries
3. Describes the methods used to estimate interim targets and Threshold Standard attainment dates
4. Describes the aggregation methods used to summarize the status and trend of indicators at the Indicator Reporting Category level
5. Provides a summary of data sources

Key Terms

The following terms are referenced throughout this Threshold Evaluation. Familiarity with these terms will aid in a more complete understanding of the document.

Environmental Threshold Carrying Capacity (Threshold Standard) – is an environmental criterion that is considered necessary for the maintenance of a significant scenic, recreational, educational, scientific or natural value of the region, or to maintain public health and safety within the region. The *Bi-State Compact* directed TRPA to adopt Threshold Standards as a means to encourage wise land use and conservation of the waters of Lake Tahoe and resources of the surrounding area. Adopted TRPA Threshold Standards are categorized in TRPA Resolution 82-11 as “Numerical Standards,” “Management Standards,” or “Policy Statements.”

Other Standards – Similar to TRPA Threshold Standards, local, state and federal agencies have adopted air and water quality standards to protect environmental quality and human health. According to the *Regional Plan (Code of Ordinances 16.10)*, TRPA is required to evaluate compliance with applicable local, state and federal air and water quality standards as a component of the Threshold Evaluation.

Interim Target – is an intermediate numeric objective related to a standard that is expected to take several years to achieve (e.g., old growth forest standards). Interim targets express Regional progress toward an adopted standard. TRPA defines an interim target as a goal that it anticipates achieving at a major evaluation interval specified for the standard.

Indicator – a measurable parameter or constituent that provides information about environmental, social, or economic conditions, and directly informs the status of an adopted Threshold Standard. Indicator values are evaluated relative to interim targets or adopted Threshold Standards and historical values to determine status and trends. According to the *Code of Ordinances* (Chapter 16, 16.3), an indicator is “*any measurable physical phenomena within the Tahoe region whose status, according to the best available scientific information, has a direct relationship to the status of attainment or maintenance of one or more threshold [standards] or [local, state or federal air and water quality] standards.*”

Compliance Measure – is a program, regulation, or action within the Tahoe region that is intended to reduce, avoid, or remedy an environmental impact, or to promote attainment or maintenance of any standard. Compliance measures include, but are not limited to, capital improvements, operational improvements, or controls on additional development.

Supplemental Compliance Measure – is a compliance measure that is not currently being implemented, but which TRPA may implement at a later date to assist in attaining or maintaining a standard.

Threshold Standards and Local, State, and Federal Air and Water Quality Standards

Under its *Regional Plan*, TRPA is required to evaluate and report on the progress toward Threshold Standards or interim target attainment, as well as the attainment of applicable local, state and federal air and water quality standards at least every 5 years (*Code of Ordinances*, Chapter 16, §16.9).

Resolution 82-11 (Appendix B) provides a list of adopted TRPA Threshold Standards for which the *Regional Plan* was designed to achieve. These are the Threshold Standards considered in this evaluation. Numerous state and federal air and water quality standards also have been established for the Tahoe Basin (Table 2-1). However, the only air and water quality standards considered in this Threshold Evaluation are those: 1) for which data exist, and 2) that were evaluated and reported by a state or federal agency. There are no unique air and water quality standards adopted by local agencies for the Lake Tahoe Region. Methodologies used to evaluate the different types of standards are summarized below.

Evaluation of Numerical Standards and Management Standards with Numeric Targets

Numerical Standards and Management Standards with numeric targets are quantitative expressions of environmental condition thought necessary to maintain a significant scenic, recreational, educational, scientific or natural value of the region, or to maintain public health and safety within the region consistent with the *Bi-State Compact*. Numerical Standards and Management Standards with numeric targets provide a quantitative basis for evaluation of environmental or socioeconomic conditions in the Lake Tahoe Region.

A major purpose of this Threshold Evaluation is to report indicator status and trend relative to Numerical Standards or Management Standards with numeric targets. In addition, this evaluation provides estimates of the confidence in status and trend determinations, which informs the level of confidence in determining the progress to attain or maintain a Threshold Standard. The following

questions are central to the evaluation of Numerical Standards and Management Standards with numeric targets:

- *What is the status of the indicator relative to the adopted standard (and/or interim target)?*
- *How has the indicator changed over time (i.e., what is its trend)?*
- *What is the level of confidence in the assessment of indicator status and trend?*

Criteria for indicator status, and trend and confidence determinations for Numerical Standards were incorporated in this evaluation to standardize these determinations across indicators, and to ensure consistency in determinations among producers of Indicator Summaries. Results of an indicator's status, trend, and confidence determinations are presented in reporting icons, which are intended to clearly communicate the essential results. The approach and criteria used to determine the components of a reporting icon consisted of four steps:

- 1) Identify and articulate the indicator and its associated environmental or socioeconomic standards (and/or interim target).
- 2) Determine indicator status based on the most current indicator value.
- 3) Evaluate the trend in indicator values using available data collected over time.
- 4) Assign a combined confidence rating to the indicator status and trend determinations.

These four steps are described in detail below.

- 1) **Identify Indicator and Standard:** The first step in determining the reporting icon was to identify the indicator and the associated Numerical Standard (and/or interim target) to be evaluated. Standards (and/or interim targets) and indicators were identified from one of three sources: 1) TRPA Resolution 82-11, Exhibit C (inserted as Appendix B in this report), 2) past TRPA Threshold Evaluation Compliance Forms, or 3) state and federal air and water quality standards (Table 2-1).

Table 2-1. Sources of applicable state and federal air and water quality standards.

Jurisdiction	State or Federal Implementing Agency	Implementing Document	Source
Air Quality			
Nevada	Nevada Division of Environmental Protection (NDEP) – Bureau of Air Quality Planning	Nevada Administrative Code - 445B.22097	http://ndep.nv.gov/baqp/monitoring/aaqstd.html
California	California Air Resources Board (CARB)	California Health & Safety Code section 39606	http://www.arb.ca.gov/research/aaqs/caaqs/caaqs.htm
United States of America	Environmental Protection Agency (EPA)	Clean Air Act	http://www.epa.gov/air/criteria.html

Water Quality			
Nevada	Nevada Division of Environmental Protection (NDEP) – Bureau of Water Quality Planning	Nevada Administrative Code (NAC), Chapter 445A.118-445A.225	http://www.leg.state.nv.us/nac/nac-445a.html#NAC445ASec1905
California	California Water Boards Lahontan Region	Lake Tahoe Basin Plan	http://www.swrcb.ca.gov/rwqcb6/water_issues/programs/basin_plan/docs/ch5_laketahoebasin.pdf

- 2) **Determination of Indicator Status:** This Threshold Evaluation assigns a status to an indicator based on the degree of divergence from the standard, interim target, or numerical management target, instead of the less informative pass/fail status determination used in previous Threshold Evaluations. The background color of the reporting icon communicates the indicator “status” or estimate of current condition. For numerical standards, the status of an indicator was classified into “better” or “worse” categories based on the percent divergence of the most current indicator value from the standard or interim target (Figure 2-1).

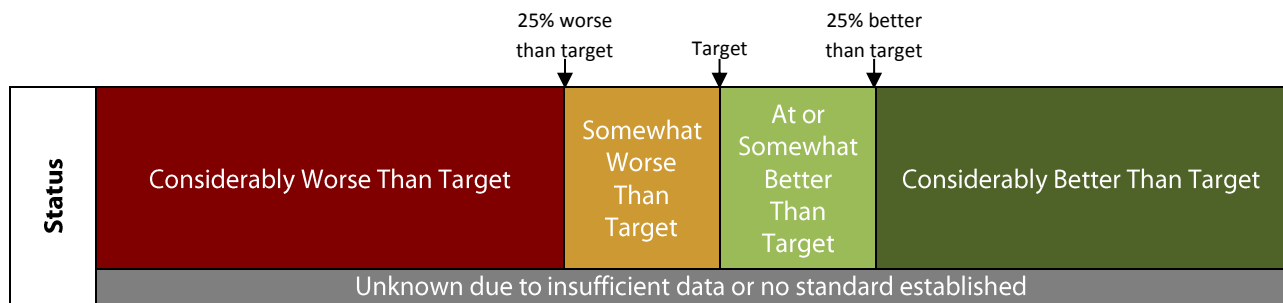


Figure 2-1. Categories of indicator status and the colors assigned to each category. Status determinations were based on the percent divergence of the most current indicator value from the standard or interim target.

Three types of Numerical Standards are commonly used in the Lake Tahoe Basin:

- “Achieve the Minimum” Standards – standards that mandate a minimum numeric level for a given indicator (e.g., depth of lake transparency, or number of special interest wildlife species population sites)
- “Not to Exceed” Standards – standards that mandate indicator condition or level not exceed a maximum numeric value (e.g., ozone concentration, community noise level).
- “Maintain within Range” Standards – standards that mandate maintaining a value that is between a minimum and maximum numeric level for a given indicator (e.g. percent cover of forest vegetation type).

The categorization of standards and targets was important because it influenced the calculation and interpretation of attainment status. Wherever possible, the “percent to target” approach was used to determine the level of standard attainment or non-attainment. Percent to target yields a simple expression of how close an indicator is to a standard or target. Attainment was generally thought to

occur when an indicator was equal to or better than the established standard or target. This approach is commonly used to assess attainment of socioeconomic and environmental goals, or overall system performance (e.g., Chesapeake Bay Program¹), because it is based on straightforward calculations and is readily understood. It also works well with the categories of status determinations (Figure 2.1), regardless of where the category boundaries are set. One criticism of this approach is that it assumes changes in an indicator value occur in a linear fashion over the entire range of the indicator. Yet we know this may not be the case for some indicators. For example, a change in Lake Tahoe transparency from a depth of 75 to 74 feet requires only a very small increase in the number of suspended particles when compared to a change in transparency from a depth of 5 to 4 feet, because of the behavior of light transmission through a column of water. At shallower depths, substantially more suspended particles would be required to influence one's ability to detect a change in transparency from 5 to 4 feet. In most cases, however, the distance between an indicator value and the standard or interim target represents only a portion of the full potential range of indicator values, and it is assumed that this distance can change in a linear fashion for this evaluation.

To calculate percent to target, the indicator measurement from the most current evaluation year was divided by the standard or interim target and multiplied by 100.

$$\text{Percent to Target} = \text{Most Current Years' Measurement} / \text{Target} * 100$$

A hypothetical example calculation of percent to target for winter lake transparency is as follows:

$$73/85.8 * 100 = 85\%$$

To interpret the results of the winter lake transparency percent to target calculation, we first determined that it was an *"achieve the minimum"* standard. Further, we determined that an interim target of 85.8 ft. has been established. The percent to target calculation reveals that 2010 winter lake transparency is 85 percent of the interim target, or 15% below the target. Thus, winter lake transparency would be categorized as *"somewhat worse than target"* because it is less than 25% away from and below the interim target.

For *"achieve the minimum"* standards, the following categories were used to determine the color (and level of attainment) of the reporting icon:

- **Dark Green** – *"Considerably Better than Target"* - the current year's value must be more than 25% better than the standard or interim target
- **Light Green** – *"At or Somewhat Better than Target"* - the current year's value must be at least equal to the standard or interim target, but not more than 25% better than the standard or interim target
- **Yellow** – *"Somewhat Worse than Target"* – the current year's value must be at least 75% of the standard or interim target but not greater than the standard or interim target
- **Dark Red** – *"Considerably Worse than Target"* – the current year's value must be more than 25% worse than the standard or interim target

For the *"not to exceed"* standards, the following categories were used to determine the color (and level of attainment) of the reporting icon:

¹ <http://www.chesapeakebay.net/>

- **Dark Green** – “Considerably Better than Target” - the current year’s value must be less than 75% of the standard or interim target
- **Light Green** – “At or Somewhat Better than Target” - the current year’s value must be at least 75% and no greater than the standard or interim target
- **Yellow** – “Somewhat Worse than Target” – the current year’s value must be just above the standard and not exceed the standard or interim target by more than 25%
- **Dark Red** – “Considerably Worse than Target” – the current year’s value must exceed the standard or interim target by more than 25%

For the “*maintain within range*” standards, attainment was relatively easy to determine if the current year’s value fell within the prescribed range. However, if the value was above or below the prescribed range, one needed to first determine which side of the prescribe range the current year’s value fell, and then needed to calculate the percent to target. If the current year’s value was below the lower range of the prescribed target, the percent to target was calculated as follows:

$$\text{percent to target} = \text{most current year's measurement} / \text{low range of target} * 100$$

If the most current year’s value was above the upper range of the prescribed target, percent to target was calculated as follows:

$$\text{percent to target} = \text{most current year's measurement} / \text{high range of target} * 100$$

For example, a TRPA Threshold Standard for vegetation requires that the immature Red Fir forest type be maintained between 15% and 25% of the upland Basin landscape, on an acreage basis. If the current measured value of this forest type was below the required lower limit, say 10%, the following calculation would be used:

$$10\% (\text{measured value}) / 15\% (\text{low range of the target}) * 100 = 66\%$$

If the current measured value of this forest type was above the range required by the upper limit for immature Red Fir forest type, for instance, 28%, the following calculation would be used:

$$28 (\text{measured value}) / 25 (\text{upper limit of range}) * 100 = 112\%$$

The following categories were used for determining the color (and level of attainment) of the reporting icon:

- **Dark Green** – “Considerably Better than Target” – this color choice was not available to characterize the status of ‘*maintain within range*’ standards because there is no basis to judge an indicator’s status if it falls within the prescribed range
- **Light Green** – “At or Somewhat Better than Target” – the current year’s value must be within the range of values prescribed by the standard
- **Yellow** – “Somewhat Worse than Target” – if the current year’s value falls below the low range of the standard, the percent to target value must be no less than 75% and no greater than 99% of target. If the current year’s value falls above the high range of the prescribed target, the percent to target value must be no less than 101% and no greater than 125% of target
- **Dark Red** – “Considerably Worse than Target” – if the current year’s value falls below the low range of the prescribed target, the percent to target value must be no greater than 75% of target;

if the current year's value falls above the high range of the prescribed target, the percent to target value must be greater than 125% of the target

- 3) **Evaluation of Indicator Trend:** To improve consistency of trend determinations across indicator evaluations, categories of trend trajectories were developed (Figure 2-2, Table 2-2). The trend arrow represented in the reporting icon describes the indicator "trend" or change in the indicator value relative to the standard or interim target over time. In general, a trend arrow depicted in the reporting icon represents the trend that was derived using all available data for an indicator unless otherwise noted in the data evaluation and interpretation narrative. In some cases with a long-term dataset, the trend arrow depicted in the reporting icon represents examination of the most recent data thereby characterizing the near-term trend. In these cases, the trend determination is based on at least the previous 5 evaluation periods². In cases where only recent data were available representing at least 3 evaluation periods, a trend determination was made; however the level of confidence assigned to the trend determination was low, due to the limited amount of data. In other cases, a trend determination was not made due to insufficient data (i.e., < 3 evaluation periods) so a "diamond" was used in the reporting icon, indicating that no trend was determined. In all cases, details of the trend determination in the reporting icon are disclosed in the "Data Evaluation and Interpretation" section of each Indicator Summary.

A simple linear regression was the primary analytical approach used to estimate indicator trends from available data. However, data for several indicators were analyzed using different analytical approaches due to the specific characteristics of the data, and knowledge about the responses of the indicator to various environmental factors. Methods for modified analytical approaches are explained in the chapter or Indicator Summaries, containing the specific results of the modified analysis.

Simple linear regression is a statistical method that provides an equation for a straight line through a set of data points plotted on x (time) and y (indicator value) axes of a graph. The resulting line is considered the 'best fit' line given the associated variability in the data set.³ The slope of the best-fit line represents the modeled change in y (indicator values) over the change in x (time). To test if the slope was significantly different from zero (a slope of zero indicates no change in trend), data were first plotted to determine if a linear relationship was apparent, and if so, a two-tailed t-test was performed. The coefficient of determination was also evaluated to provide a measure of how well future outcomes are likely to be predicted by the regression model. The coefficient of determination (r^2) estimates the proportion of the variation in the y-values that is explained by the fitted line. The coefficient of determination may be thought of as a measure of the strength of the straight-line relationship, with values ranging from 0 (no strength) to 1 (maximum strength). It is important to note that this method does not take into account nonlinear trajectories (e.g., polynomial models) or complex interactions that can lead to trajectories exhibiting step-functions, or changing cyclical patterns common in wildlife populations. Other

² Evaluation periods vary among indicators and depend on the frequency of data collection as well as the data aggregation approach. For example, the evaluation period for annual Secchi disk depth is once per year, although the annual value is an average of measurements taken during each month of the year. In contrast, assessments of major vegetation communities throughout the Tahoe Basin only occur about once every five years.

³ The criterion for 'best fit' generally employed uses the concept of 'least squares.' The least squares criterion considers the vertical deviation of each point from the line, and defines the best fit line as that which results in the smallest value for the sum of the squares of these deviations for all values.

statistical approaches are more appropriate in these cases. It also is important to note that a linear regression (and other regression analyses) tests how well two variables are correlated with one another and assumes that the y-values (indicators) are functionally dependent on the x-values (time). However, it is recognized that a significant linear regression does not establish a cause-effect relationship.

Determination of trend significance was made using the methods described in the “Confidence in Status and Trend Determination” section below.



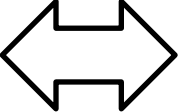

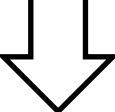
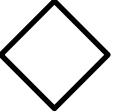






					
Rapid Improvement	Moderate Improvement	Little or No Change	Moderate Decline	Rapid Decline	Insufficient Data to Determine Trend

Figure 2-2. Categories of trend determinations represented in the reporting icon. If data were limited such that a trend could not be determined a diamond shape was used in the reporting icon.

Table 2-2. Indicator trend categories and associated definitions used to classify trends relative to standards in the reporting icon.

INDICATOR TREND CATEGORY	DEFINITION ⁴
Rapid Improvement 	The slope of the indicator trend is in the improving direction and the absolute % change per year (or evaluation period) relative to the target is better than or equal to 2.5%.
Moderate Improvement 	The trend slope is in the improving direction and the absolute % change per year (or evaluation period) relative to the target is between 2.4% and 0.5%.
Little or No Change 	The trend slope is flat (horizontal) or marginally improving or declining relative to the target and the absolute % change per year (or evaluation period) relative to the target is between 0% and +/- 0.5%.
Moderate Decline 	The slope is in the declining direction relative to the target and the absolute % change per year (or evaluation period) is between 0.5% and 2.5%.
Rapid Decline 	The slope is in the declining direction and the absolute % change per year relative to the target is greater than 2.5%.
Insufficient Data to Determine Trend 	Trend could not be determined due to insufficient data, highly variable data, or due to differences in analytical approach used across years.

Estimating Interim Targets

The approach used to estimate an interim target in all cases is documented in the Indicator Summary. Generally, interim targets were estimated using one of the following approaches:

⁴ To determine % change relative to the target the following equation was used:

$$\text{Percent change} = \text{absolute linear regression slope value (Beta)} / \text{interim target or standard}$$

- Trend lines were extended out 5 years (major evaluation period) and a horizontal line was constructed from the endpoint of the extended trend line to the y-axis. The intersection of the horizontal line with the y-axis was used to estimate an interim target for that indicator.
- If the indicator was meeting the standard, then no interim target was estimated as standard was determined to be in attainment.
- In limited cases, best available scientific findings were used to estimate interim targets (e.g., annual average Lake transparency).

Estimating Threshold Standard Attainment Dates

The approach used to estimate an attainment date in all cases is documented in the Indicator Summary. Generally, Threshold Standard attainment dates were estimated using one of the following approaches:

- For indicators with a trend line trajectory moving towards the Threshold Standard, trend lines were extended until they intersected with a horizontal line representing the standard. A vertical line was constructed from the intersection of the extended trend line and the line representing the Threshold Standard to the x-axis. The intersection of the vertical line with the x-axis was used to estimate an attainment for that indicator.
- If the Threshold Standard is determined to be in attainment, no attainment date is estimated.
- In limited cases, best available scientific findings were used to estimate attainment dates (e.g., annual average Lake transparency).

- 4) **Confidence in Status and Trend Determinations:** The border surrounding the reporting icon describes how much “confidence” there is in the determination of an indicator’s status and trend relative to the standard, interim target or numeric management target. A confidence rating was assigned to the combined status and trend determination in order to provide the reader a sense of the relative strength or weakness in the available data and the associated analysis, and to aid in identifying areas for monitoring program improvement. Confidence rating categories used for reporting icon included “High,” “Moderate” and “Low.” The following steps and criteria were used to assign a confidence rating to status and trend determinations.

Confidence in Status Determination

Confidence in status was determined based on three factors:

1. *Protocols Used:* For this factor, we evaluated if a documented, reviewed and accepted monitoring protocol was used to guide the collection, analysis and reporting of the indicator.
2. *Data Continuity, Recent Data, and Quality Assurance:* All of the following needed to be true for an affirmative evaluation of this factor.
 - a. Data were collected consistently for 2 or more monitoring periods.
 - b. Most recent data were less than 2 monitoring periods old.
 - c. Data were subject to quality control and assurance requirements.
3. *Spatial and Temporal Representation:* Evaluation of this factor examined if the distribution of the sampling effort was supported by a sampling design analysis, a scientifically supportable qualitative rationale, or criteria established by appropriate authorities (e.g., EPA criteria for establishing air quality monitoring sites). Either approach infers that the spatial and temporal representativeness of the monitoring effort adequately characterizes regional conditions for the resource or condition considered.

“High” confidence in a status determination required affirmative fulfillment of all of these factors. “Moderate” confidence in status determination required fulfillment of 2 out of the 3 factors, and “Low” confidence was assigned if 1 or none of the factors were fulfilled.

Confidence in Trend Determination

Confidence determination for the trend depended on three factors evaluated in sequence:

- 1) *The duration of trustworthy data*: Trustworthy data had to be available for at least as long as needed to observe a material change in the indicator. Low confidence in the trend was automatically assigned if this factor was not met. If this factor was met, then the subsequent factors were used to further evaluate the confidence in trend.
- 2) *The coefficient of determination (r^2)*: An r^2 value ≥ 0.75 had to exist in order to assign “high” confidence in the trend. An r^2 value between 0.50 and 0.74 had to exist in order to assign “moderate” confidence in the trend. An r^2 value ≤ 0.50 resulted in an assignment of “low” confidence in the trend.
- 3) *A statistical test to evaluate if the slope of the regression line differed significantly from zero (p-value)*: The following p-values were used to assign a confidence rating to the trend determination for this factor:

Trend Confidence Rating	P-Value
High	≤ 0.10 (at least 90% confident the test result was not due to chance)
Moderate	0.11 to 0.4 (60 to 89% confident the test result was not due to chance)
Low	> 0.40 (less than 60% confident the test result was not due to chance)

The final confidence determination for trend was determined based on the outcomes of all three factors as described in Table 2-3.

Table 2-3. Trend confidence determinations based on both the r^2 -value and t-test significance. All of these determinations assumed that the duration of trustworthy data factor was affirmatively met. If not, then the final confidence determination for trend was low.

P-value: t-test significance	r^2 -value		
	$r^2 > 0.75$	$0.75 \geq r^2 \geq 0.5$	$r^2 < 0.5$
$p < 0.1$	High	Moderate	Low
$0.4 > p > 0.1$	Moderate	Moderate	Low
$p > 0.4$	Low	Low	Low

In instances where a trend determination was made without a statistical analysis (i.e., the data were simply graphed and interpreted) the trend determination was automatically assigned a “low” confidence rating.

Overall Confidence

The overall confidence was determined by comparing the separate status and trend confidence rating determinations. These comparisons assumed the separate confidence ratings carried equal weight. The following rules were used to establish an overall confidence rating.

Status & Trend Confidence Rating	Overall Confidence Rating
Same	Use this confidence category
One confidence rating is High, and one is Low	Medium
One confidence rating is High and other is Medium, or one is Medium and other is Low	Use the lower confidence rating

Aggregation of Status, Trend, and Confidence

Previous TRPA Threshold Evaluations grouped related Threshold Standards and indicators into “threshold indicators” in order to provide an overall “attainment” status for a group of related indicators within a common theme (e.g., water quality or fisheries). However, the methodology for aggregating status and trend of dissimilar indicators and standards was never well documented. In general it appeared that previous evaluations took a very conservative approach for characterizing the attainment status at the “threshold indicator” level (a “threshold indicator” is similar to Indicator Reporting Category terminology used for this report). A “threshold indicator” was deemed to be in “non-attainment” if any of the standards within the “threshold indicator” were out of attainment in any of the years considered in the evaluation period. Further, it appeared that characterizations of the overall trend for a “threshold indicator” were based on staff’s best professional judgment; no accepted analytical techniques were used to make a determination on trend.

Using this approach meant that if one indicator within a “threshold indicator” did not meet the adopted Threshold Standard in any one of the years within the evaluation period, a resulting determination of “non-attainment” was concluded for the entire “threshold indicator.” An unfortunate result of the previous approach was the common misconception that an attainment determination for a “threshold indicator” represented the attainment status and trends of the indicators associated with individual Threshold Standards. For example, if any of the indicators associated with Threshold Standards for Special Interest Species were out of attainment, in any of the years within the 5-year evaluation period, the Special Interest Species “Threshold Indicator” was determined to be in “non-attainment.” In this case, there may have only been one indicator out of compliance with the Threshold Standard, yet all standards within the “Threshold Indicator” were determined to be “non-attainment.” Clearly, this approach did not accurately reflect the status of all indicators within a “Threshold Indicator.”

For this Threshold Evaluation, a simple, objective system was developed to improve the consistency and transparency of status, trend and confidence characterizations at the Indicator Reporting Category level (Figure 2-3), while preserving the results for individual Threshold Standard compliance

determinations. The Indicator Reporting Categories are the indicator themes adopted in TRPA Resolution 82-11. These categories provide the framework for grouping adopted Threshold Standards. Steps in the aggregation system included:

1. Document the status score for each indicator within an Indicator Reporting Category per Figure 2-3.
2. Document the trend score for each indicator within an Indicator Reporting Category per Figure 2-3.
3. Document the confidence score for each indicator within an Indicator Reporting Category per Figure 2-3.

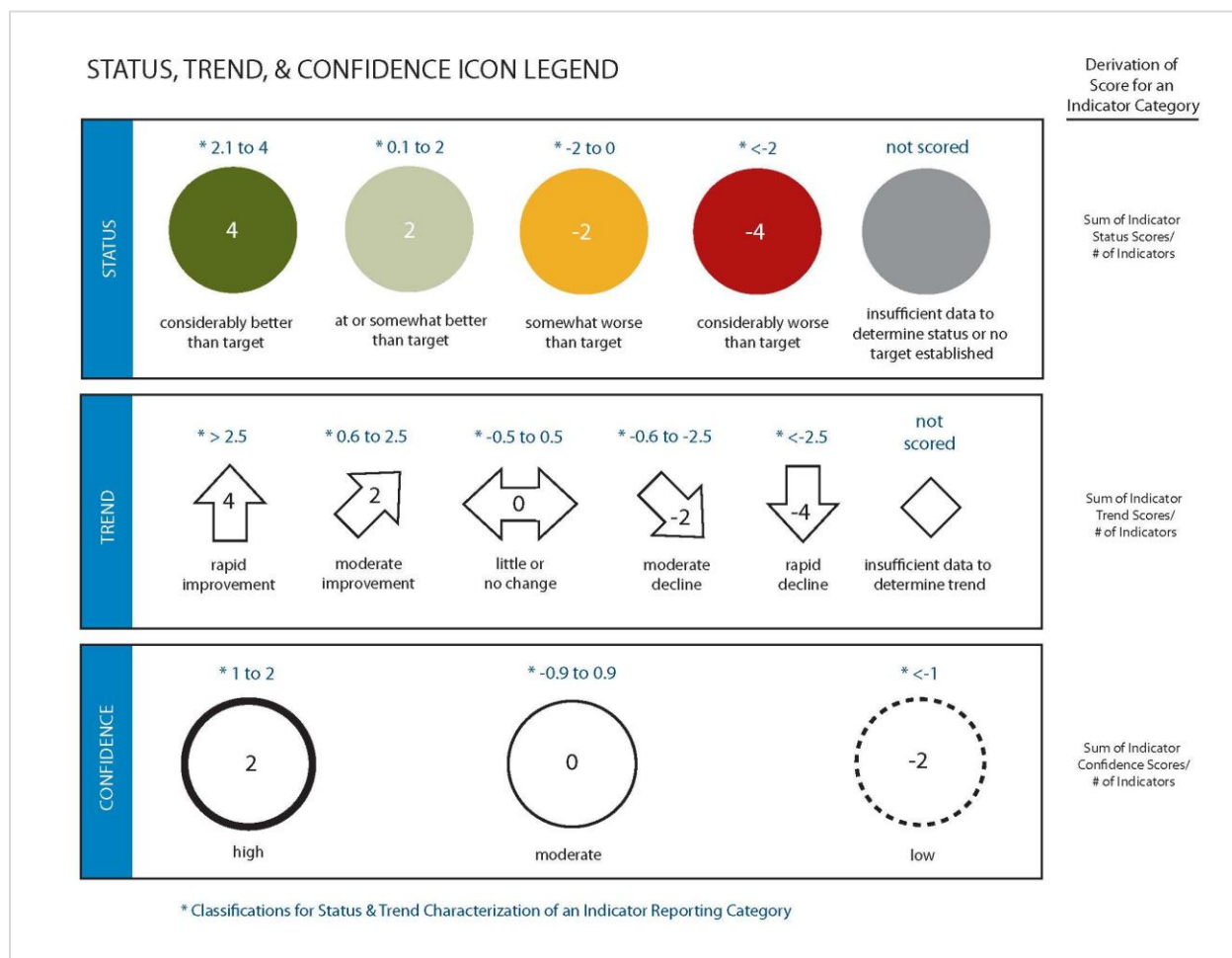


Figure 2-3. Scoring system used to aggregate status, trend and confidence ratings to the indicator reporting category level.

The aggregate determinations of status, trend, and confidence were based on the average scores within an Indicator Reporting Category. Exception to this approach occurred when an Indicator Reporting Category contained only one indicator or when there were several indicators within an Indicator Report Category, for which an “unknown” determination was made. In cases where only one indicator was evaluated, the reporting icon results for the individual indicator were used as the result for the associated Indicator Reporting Category. In cases where multiple indicators within an Indicator Reporting Category were determined to be “unknown,” aggregation calculations and overall characterization were made. However it was clearly disclosed which indicators were excluded from

the aggregation calculation and the confidence rating was reduced. In all cases, the aggregation was performed simply to summarize the overall status, trend, and confidence of all indicators within an Indicator Reporting Category. In no instance should these overall summary characterizations be misconstrued as a representation of Threshold Standard “attainment” or “non-attainment.” An example application of the aggregation system is provided in Table 2-4 and Figure 2-4.

Table 2-4. Aggregation matrix used to determine overall status, trend, and confidence for the Sensitive Plants Indicator Reporting Category. Aggregation results are shown using reporting icons in Figure 2-4.

Indicators	Status Scores	Trend Scores	Confidence Scores
Tahoe yellow Cress	4	2	2
Tahoe draba	4	0	0
Long-petaled Lewisia	4	0	0
Cup Lake draba	4	0	0
Galena Creek rockcress	Not scored	Not scored	Not scored
Average Scores	3	0.5	0.5

This aggregation method was also used to summarize the status of indicators compounded within Indicator Reporting Category subcategories. For example, for scenic resources, it was necessary to aggregate the status of the 860 unit-specific evaluations into one of five Indicator Reporting Categories subcategories (i.e., Roadway Travel Units, Roadway Scenic Quality Ratings, Shoreline Travel Units, Shoreline Scenic Quality Ratings, Recreation and Bike Trail Scenic Quality Ratings).

Overall Status and Trend of Sensitive Plants Indicator Reporting Category

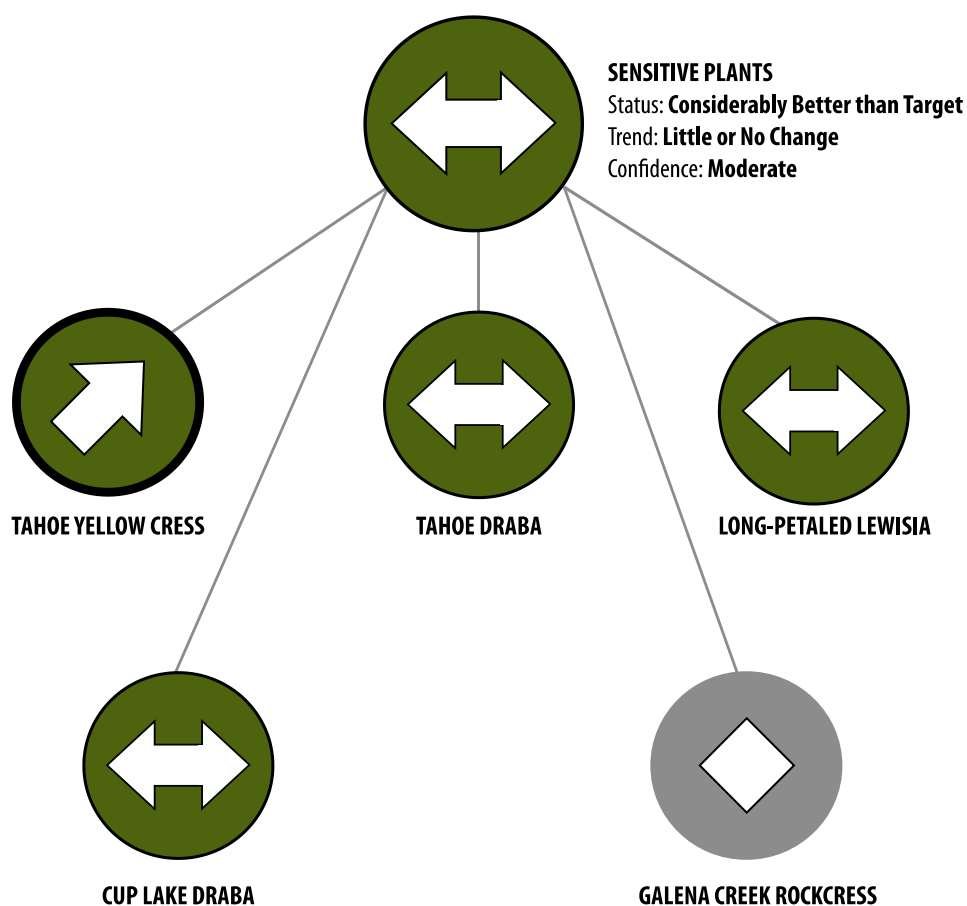


Figure 2-4. To characterize the overall status of the Sensitive Plants Indicator Reporting Category, the above example summary figures were used. In this example, reporting icons for the five indicators evaluated in the Sensitive Plants Indicator Reporting Category are used. Results from each of the five indicators were evaluated and aggregated according to the scoring system. In this example, the status of individual indicators is presented in concert with the summary aggregation of status, trend, and confidence allowing the reader to clearly understand both the status of individual standards, and which indicators are influencing the summary determination made at the Indicator Reporting Category.

Evaluation of Management Standards and Policy Statements

Management Standards and Policy Statements that did not establish numerical standards (i.e., narrative standards) were evaluated differently. The summary write-ups are formatted similarly to numerical indicator summaries (see Chapter 1 for a description); however the write-ups differ in that characterizations of trends or confidence are not included.

To evaluate qualitative or narrative management standards, the following questions were addressed:

- *Has TRPA (and/or other authorities) included provisions and requirements in permit processes that adhere to the Management Standard adopted in Resolution 82-11?*
- *Has TRPA (and/or other authorities) adopted programs that satisfy the intent of the Management Standard?*
- *Is there evidence to suggest these actions are effective in achieving the intent of the Management Standard?*

There are many instances in Resolution 82-11 where Management Standards provide management directives and numerical targets together. In these instances, the numerical elements of the Management Standards were evaluated in a manner similar to a Numerical Standard if data were available and of sufficient quality (see above).

According to TRPA Resolution 82-11, Policy Statements were identified to provide specific direction to agency staff in developing the *Regional Plan*. Policy Statements are not Numerical Standards or Management Standards but are instead, principles or rules intended to guide decisions needed to achieve a desired outcome or value. To evaluate Policy Statements, the following questions were addressed:

- *Has TRPA (and/or other authorities) adopted policies or regulations, permit requirements, or implemented other programmatic efforts to satisfy the Policy Statement adopted in Resolution 82-11?*
- *Is there evidence to suggest these actions are effective at achieving the intent of The Policy Statement?*

A qualitative evaluation and narrative description of Policy Statement implementation was included for each Policy Statement relative to the associated Indicator Reporting Category.

Sources of Status and Trend Data and Information

Although TRPA collects status and trend data on a number of indicators, the agency depends on multiple agencies and research institutions for data and information used to evaluate the status and trend of indicators relative to Threshold Standards. Below is a summary of the major data and information sources, organized by Threshold Category.

Water Quality – Lake Tahoe data were provided by UC Davis - Tahoe Environmental Research Center (UC Davis). Information on tributary water quality was provided by the US Geological Survey – Nevada Water Science Center (USGS) in partnership with UC Davis. Other information on water quality was derived from Nevada Division of Environmental Protection and California Water Board - Lahontan Region reports. Collection of water quality data is funded by TRPA, U.S. Forest Service – Lake Tahoe

Basin Management Unit (LTBMU), USGS, Lahontan Regional Water Quality Control Board, and UC Davis.

Air Quality – Air pollutant data and published monitoring reports were provided by the California Air Resources Board, and US Environmental Protection Agency through their respective web-based data portals. Washoe County Air Management District, Placer County Air Management District and El Dorado County Air Management District provide data to US EPA and California Air Resources Board. Desert Research Institute was retained by TRPA to conduct analysis of available data. Funding for data collection is provided by the above listed agencies.

Soil Conservation – Natural Resources Conservation Service (NRCS) provide updated information for the Lake Tahoe Basin via personal communication and through recent publications. Watershed Sciences, LLC., provided 2010 airborne LiDAR data. Digital Globe (Worldview-2 satellite) provided 2010 multispectral satellite imagery. Spatial Informatics Group, LLC, and the University of Vermont conducted preliminary analysis of impervious cover through a grant provided by Southern Nevada Public Lands Management Act. Data on stream restoration progress were provided by the U.S. Forest Service – LTBMU, California Tahoe Conservancy, and Nevada Division of State Land.

Wildlife – Data and information on special status wildlife species were provided the U.S. Forest Service – LTBMU, in partnership with TRPA, California Department of State Parks, Nevada Division of Wildlife, California Tahoe Conservancy, California Department of Fish and Game, and U.S. Fish and Wildlife Service. Dr. Michael Morrison, of Texas A & M University, was retained to provide technical oversight of analysis performed by TRPA.

Fisheries – Data, analysis, and information presented in this report were provided by the U.S. Forest Service – LTBMU, U.S. Fish and Wildlife Service, TRPA contractors, California Department of Fish and Game, Nevada Division of Environmental Protection, Nevada Department of Wildlife, University of Nevada, Reno, Humboldt State University, and Lahontan Regional Water Quality Control Board. Much of the funding for fisheries-related research was provided through the Southern Nevada Public Lands Management Act grant program.

Recreation – Data and information were provided by TRPA and U.S. Forest Service – LTBMU. Review of evaluation and constructive input was provided by California Tahoe Conservancy staff.

Scenic Resources – TRPA, in partnership with the U.S. Forest Service – LTBMU, and under agreement with scenic quality experts, collected and analyzed scenic quality data presented in this report. TRPA funded data collection, analysis and reporting of scenic quality data.

Vegetation – The U.S. Forest Service – LTBMU, and the U.S. Forest Service Region 5 Ecologist, played a substantial role in collecting, analyzing, and reporting data on rare plants, uncommon plant communities, and common vegetation. TRPA retained Alison Stanton, a consulting rare plant specialist, to compile available data, conduct analyses, and prepare reporting materials for this evaluation.

Noise - The City of South Lake Tahoe Airport provided quarterly reports to TRPA on airport-related noise. Otherwise, TRPA staff collected and analyzed all noise data for this evaluation.